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Understanding the fungicides that will kill Asian soybean rust

Alison Robertson
Iowa State University, alisonr@iastate.edu

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Abstract
Most of the fungicides approved for Asian soybean rust management in Iowa, and the United States, belong to either the chloronitrile, strobilurin, or triazole chemical groups. These groups all have different effects and modes of action; therefore, it is essential to understand how each group functions to protect soybean crops from infection by Phakopsora pachyrhizi and subsequent Asian soybean rust disease development.

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Plant Diseases

Understanding the fungicides that will kill Asian soybean rust

by Alison Robertson, Department of Plant Pathology

Most of the fungicides approved for Asian soybean rust management in Iowa, and the United States, belong to either the chloronitrile, strobilurin, or triazole chemical groups. These groups all have different effects and modes of action; therefore, it is essential to understand how each group functions to protect soybean crops from infection by *Phakopsora pachyrhizi* and subsequent Asian soybean rust disease development.

Fungicides can be classified according to where in the disease cycle they are active. A fungicide that is effective prior to infection and the initiation of the disease cycle is referred to as a preventative or protectant. In contrast, some fungicides are effective against the fungus growing in the leaf tissue and, therefore, have curative properties.

Chloronitriles

(e.g., chlorothalonil [Bravo®, Echo®, Chloronil®])

This group of fungicides inactivate sulfur-containing enzymes of the fungus and, as a result, disrupt energy production by the fungus. They are active only against spore germination and are protectants. Chloronitriles have a residual period of 7 days.

The fungicides remain on the leaf surface and are not absorbed by plant leaves; therefore, these chemicals often are referred to as contact fungicides.

Strobilurins

(e.g., azoxystrobin [Quadris®], pyraclostrobin [Headline®])

The strobilurins are more correctly referred to as the Q_0I fungicides. This name refers to their mode of action. Spores of fungi are more susceptible to strobilurins than strands of the fungus body (mycelium). Strobilurins are highly effective against spore germination and early penetration of the host. Once the fungus is growing inside the leaf tissue, strobilurins have little or no effect. Strobilurins function primarily as protectants. Most strobilurins have a residual period of approximately 21 days.

Strobilurins are locally systemic.[1] When applied to a leaf, each droplet of a strobilurin fungicide will spread out on the surface of the leaf before being absorbed by the waxy layers (cuticle) of the leaf. Strobilurins are highly attracted to the cuticle. Some strobilurin fungicide will move down through the leaf tissue to the cuticle on the other side of the leaf. This is known as translaminar activity and it may take several days to occur. Some strobilurins move systemically in the xylem of the plant.

Triazoles

(e.g., myclobutanil [Laredo EC®, Laredo EW®], propiconazole [Tilt®, Bumper®, PropiMax®], tebuconazole [Folicur®], tetraconazole [Domark®]—*section 18 pending*)

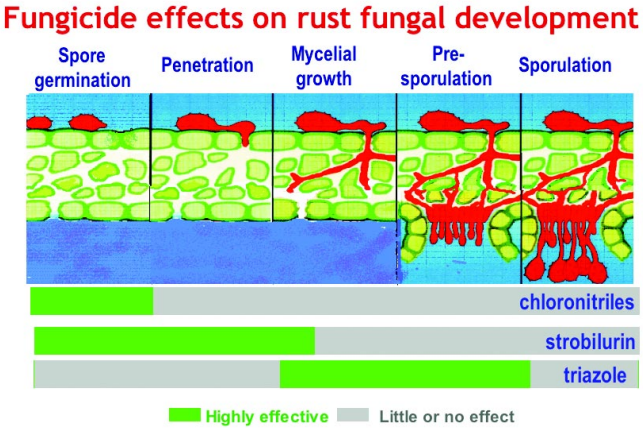
The triazoles are more correctly referred to as DMI (demethylation inhibitor) fungicides. This again refers to their mode of action. The triazoles inhibit one specific enzyme, which plays a role in sterol production. Because sterols are important components of fungal cell membranes, these fungicides result in abnormal fungal growth and death. To be effective, this group of chemicals must be present inside the plant tissue so that the fungus absorbs the active ingredient. Some triazoles reduce spore production and help to slow disease development. Triazoles have no effect against spore germination and infection of the host tissue because the germinating spores contain enough sterol for the formation of germ tubes and infection structures. Therefore, triazoles are curative fungicides. The triazoles have a residual period of about 14 days and are xylem-systemic.

Triazoles are more mobile in plant tissues than strobilurins. Following application, the active ingredient moves into the cuticle and from there it is rapidly absorbed into the leaf tissue. The triazoles are systemic and are transported upward and outward in the xylem. Diffusion of the active ingredient occurs from the xylem into the cells adjacent to the xylem. Note that triazoles are not necessarily transported from one leaf to another leaf or from one part of the soybean plant to another part.

Putting it all together

Chloronitriles are only active against spore germination. Strobilurins are highly effective at inhibiting spore germination and infection of the host tissue. Thus, both these types of fungicides are **preventative** treatments: they protect the leaf from infection and subsequent disease development. The triazoles are active on fungal growth inside the leaf tissue; they do not affect spore germination and penetration of host tissue. Therefore, they are **curative** treatments (see Figure 1). Remember, however, that this is limited curative activity; triazoles are not effective at moderate (>10 percent incidence[2] in mid-canopy) and high levels of rust infection.

Thus, all chemical groups can be used in a preventive Asian soybean rust management program; that is, **before** the disease is present in the surrounding area, but the risk of the disease is high. Triazoles or a combination of a triazole plus strobilurin should be used when soybean rust is present in the field or surrounding areas.



Source: Syngenta

Figure 1. Fungicide effects on rust fungal development.

Alison Robertson is an assistant professor of plant pathology with extension and research responsibilities in field and forage crops.

[1]Care should be taken when referring to fungicides as systemic. Most growers automatically think of herbicides like glyphosate (Roundup®). The fungicides that are available for soybean rust have **limited mobility** in the plant when compared with systemic herbicides, which is why good coverage of the entire plant canopy is essential for the fungicide to be effective.

[2]Incidence = number of leaves with soybean rust symptoms out of 100 leaves.

Left: Palle Pedersen, Department of Agronomy; José Tadashi Yorinori, a leading researcher for ASR with EMBRAPA Soja, Londrina, Parana, Brazil; and John Holmes, ISU Extension field specialist, examine leaves for signs of Asian soybean rust. ***(Joel DeJong)***